Technology: Microelectronics - SiGe

Under a licensing and royalty agreement **Parthus Technologies** and **STMicroelectronics** have co-developed a single-chip Bluetooth radio. It will use ST's BiCMOS6 SiGe process to combine very high performance with low power consumption and low bit error rates (BERs) for next-generation mobile devices. The chip uses a low-IF architecture and high levels of integration to minimise the number of external components.

ON Semiconductor plans to introduce a family of SiGe-based devices (starting in Q2/2001) aimed at OC-192, 10 Gigabit Ethernet and faster applications. ON Semiconductor's GigaComm family will perform at 12 Gb/s. Its current devices perform at 4 Gb/s (for OC-48).

Researchers have used SiGe:C to improve the performance of superlattice thermoelectric coolers (*Applied Physics Letters*, March 12). Chilling is of the order of 7°C. The carbon-doping enabled the scientists to dispense with the buffer layers usually needed to cope with lattice mismatches between layers. The researchers believe that cooling of tens of °C are possible.

25 nm HEMT reaches 398 GHz; f_T = 500 GHz targeted

As part of a national effort to develop millimetre communications technologies (usually limited to military and scientific uses) for commercial and network communications applications, Japan's **Communications Research Laboratory** (CRL) - working with Fujitsu Laboratories and Osaka University's Graduate School of Engineering Science - has developed what is claimed to be a record-frequency HEMT (InP-based, with an InGaAs channel and InAlAs barrier layers, yielding f_T = 386-398 GHz).

This should allow development, by mid-decade, of products such as 76-77 GHz automotive collision-avoidance radars, ITS trunk communications, and 100 Mb/s home LANs at 60 GHz, said Fujitsu Labs Fellow Takashi Mimura.

"We have projections of hitting 500 GHz", but the gate must be shortened from 25 nm to 10 nm, says Toshiaki Matsui, group leader of the lab's Communication Device Group.

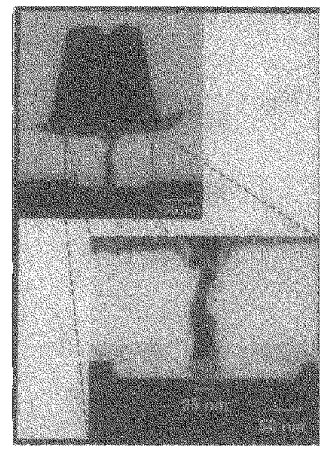
A year ago, the group achieved 362 GHz using $In_{0.53}Ga_{0.47}As$ for the free-electron channel layer structure and a lift-off technique using electron-beam lithography to form 50 nm gates. (In 1992 Hughes Electronics hit 340 GHz using a 50 nm gate; in 1998 NTT reached 350 GHz using a 30 nm gate.)

The CRL-led group optimised the e-beam lithography to form a stable 25 nm gate (the shortest in the world [using a mix of titanium, platinum and gold]) and increased the channel's indium content to 70%, boosting electron mobility 25%, said Keisuke Shinohara, a CRL researcher with Communications Device Group.

Above 20 GHz, the Ministry of Public Management, Home Affairs, Posts and Telecommunications wants to develop a national 4G communications infrastructure linking a national ITS network, together with an office-home national LAN system, to a multimedia mobile-access communications network.

All may link to the ministry's proposed Skynet system, a constellation of up to 200 giant dirigibles anchored at 20 km above Japan that will serve as cheap, extremely low-orbit stationary communications satellites.

But attenuation through oxygen severely limits ranges at 60 GHz,



A scanning electron micrograph image showing the T-gate structure of the HEMT, including detail of the 25 nm wide contact.

as do buildings and natural obstacles. And high-powered, narrow beams are unsuitable for low-cost omnidirectional planar antennas.

A 400 GHz-capable HEMT at 60 GHz achieves double the gain of the most powerful 150 GHz GaAs models. Redeveloped versions could cut four to eight amplification stages, shrinking chip sizes and costs.

Integration will probably involve flip-chipping MMICs with hybrid ICs to combine MMICs' cost advantages with the hybrid approach's low-cost aluminium substrate.

TRW spins off Velocium; developing InP PA modules with Hitachi

Hitachi Ltd (Tokyo, Japan) has agreed to jointly design and develop very high-efficiency power amplifier modules using the InP processing technology of **Velocium** (Manhattan Beach, CA, USA, led by Dr Dwight Streit as president). They are targeting sampling early next year in time for volume production of 3G W-CDMA handsets in second-half 2002.

Velocium was spun off by **TRW** (Redondo Beach, CA, USA) in May to provide high-speed InP and GaAs components for fibre-optic and wireless telecoms (include TRW's current commercial GaAs components).

TRW has invested US$70m this year in InP manufacturing capacity expansion (including the world's first 4" InP production line) and product development. Velocium's first InP product (a 40 Gb/s OC-768 integrated photoreceiver) has been available in volume since April.

HBT chip-set shrinks package for PCS/Cellular PAs by 35%

Mitsubishi Electric & Electronics USA Inc (Sunnyvale, CA, USA) has launched a chip-set of two 3.2V GaAs HBT RF amplifiers (the 1.9 GHz CDMA BA01202 and 800 MHz CDMA BA01203) for the US PCS cell-phone market. The chip-set features a 25% reduction in idle current and a 35% reduction in overall size compared to the previous model.

* Mitsubishi is also introducing a new starter kit development package for its SMD Power GaAs FET product family.

The package enables designers to quickly make full evaluations of its MGF091XF family of medium- and high-power GaAs FETs as well as providing a reference design for popular applications.